CLAIMS

1. A wireless transmitter, comprising:

a plurality of antennas, wherein each of the plurality of antennas is operable for transmitting signals;

for each of a plurality of different user channels, circuitry for providing a plurality of groups of symbols in a first symbol group sequence;

for each of the plurality of different user channels, circuitry for forming a first modulated symbol group sequence for the user channel by modulating the symbols in the first symbol group sequence for the user channel with a unique code that corresponds to the user channel and distinguishes the user channel from each other of the plurality of different user channels;

circuitry for combining the first modulated symbol group sequence for each of the plurality of different user channels such that a first combined modulated symbol sequence is provided to and transmitted by a first antenna in the plurality of antennas;

for each of the plurality of different user channels, circuitry for forming a second symbol group sequence by re-ordering the plurality of groups of symbols in the first symbol group sequence and further by time reversing symbols in at least some of the plurality of groups of symbols to form the second symbol group sequence different from the first symbol group sequence;

for each of the plurality of different user channels, circuitry for forming a second modulated symbol group sequence for the user channel by modulating the symbols in the second symbol group sequence for the user channel with a unique code that corresponds to the user and distinguishes the user from each other of the plurality of different user channels; and

circuitry for combining the second modulated symbol group sequence for each of the plurality of different user channels such that a second combined modulated symbol sequence is provided to and transmitted by the second antenna.

2. The wireless transmitter of claim 1 wherein the unique code used by the circuitry for forming a first modulated symbol group sequence is the same for a given user channel in the plurality of different user channels as the unique code used by the circuitry for forming a second modulated symbol group sequence.

3. The wireless transmitter of claim 1 wherein the unique code used by the circuitry for forming a first modulated symbol group sequence is time reversed for a given user channel in the plurality of different user channels relative to the unique code used by the circuitry for forming a second modulated symbol group sequence.

4. The wireless transmitter of claim 1 wherein the wireless transmitter further comprises circuitry for buffering a number of groups of symbols for each of the plurality of different user channels, wherein the number of groups of symbols equals the number of the plurality of antennas.

5. The wireless transmitter of claim 4 wherein the number of the plurality of antennas equals two antennas.

6. The wireless transmitter of claim 1 wherein the circuitry for forming a second symbol group sequence forms the second symbol group sequence further by determining a complex conjugate of the symbols in the first symbol group sequence.

7. The wireless transmitter of claim 6 wherein the circuitry for forming a second symbol group sequence forms the second symbol group sequence further by determining a negative of the symbols in selected groups of symbols within the first symbol group sequence.

8. The wireless transmitter of claim 1 wherein the transmitter is operable in a time division duplex mode.

9. The wireless transmitter of claim 8 code wherein each of the unique codes comprises a product of a Walsh code and a scrambling code, wherein each of the Walsh code and the scrambling code comprise a number of chips in a symbol.

10. The wireless transmitter of claim 9:

wherein the Walsh code consists of a number of chips and each symbol consists of a same number of chips as the number of chips in the unique code; and

wherein the unique code used by the circuitry for forming a first modulated symbol group sequence is time reversed for a given user channel in the plurality of different user channels relative to the unique code used by the circuitry for forming a second modulated symbol group sequence.

11. The wireless transmitter of claim 1 wherein the transmitter is operable in a frequency division duplex mode.

12. The wireless transmitter of claim 11 wherein each of the unique codes comprises a product of a Walsh code and a long code.

13. The wireless transmitter of claim 12:

wherein each group of the groups of symbols in the first symbol group sequence has a first number of chips;

wherein the long code consists of a second number of chips greater than the first number of chips; and

wherein the unique code used by the circuitry for forming a first modulated symbol group sequence is time reversed for a given user channel in the plurality of different user channels relative to the unique code used by the circuitry for forming a second modulated symbol group sequence by time reversing the first number of chips in the long code.

14. The wireless transmitter of claim 1 wherein the transmitter comprises a WCDMA transmitter.

15. A wireless network, comprising:

a wireless transmitter, comprising:

a plurality of antennas, wherein each of the plurality of antennas is operable for transmitting signals;

for each of a plurality of different user channels, circuitry for providing a plurality of groups of symbols in a first symbol group sequence;

for each of the plurality of different user channels, circuitry for forming a first modulated symbol group sequence for the user channel by modulating the symbols in the first symbol group sequence for the user channel with a unique code that corresponds to the user channel and distinguishes the user channel from each other of the plurality of different user channels;

circuitry for combining the first modulated symbol group sequence for each of the plurality of different user channels such that a first combined modulated symbol sequence is provided to and transmitted by a first antenna in the plurality of antennas;

for each of the plurality of different user channels, circuitry for forming a second symbol group sequence by re-ordering the plurality of groups of symbols in the first symbol group sequence and further by time reversing symbols in at least some of the plurality of groups of symbols to form the second symbol group sequence different from the first symbol group sequence;

for each of the plurality of different user channels, circuitry for forming a second modulated symbol group sequence for the user channel by modulating the symbols in the second symbol group sequence for the user channel with a unique code that corresponds to the user and distinguishes the user from each other of the plurality of different user channels; and

circuitry for combining the second modulated symbol group sequence for each of the plurality of different user channels such that a second combined modulated symbol sequence is provided to and transmitted by the second antenna; and

a wireless receiver for receiving transmissions by the first and second antennas.

16. The network of claim 15 wherein the wireless receiver comprises circuitry for filtering signals responsive to the transmissions by the first and second antennas.

17. The network of claim 16 wherein the circuitry for filtering comprises circuitry for despreading the signals responsive to the transmissions by the first and second antennas.

18. The network of claim 17 wherein the circuitry for filtering comprises circuitry for STTD decoding and rake processing following the circuitry for despreading.

19. The network of claim 17 wherein the circuitry for filtering comprises circuitry for despreading following circuitry for STTD decoding and rake processing.

20. The network of claim 17 wherein the wireless receiver further comprises circuitry for equalizing signals responsive to the first antenna separately from circuitry for equalizing signals responsive to the second antenna.

21. The network of claim 15:

wherein the unique code used by the circuitry for forming a first modulated symbol group sequence is time reversed for a given user channel in the plurality of different user channels relative to the unique code used by the circuitry for forming a second modulated symbol group sequence; and

wherein the wireless receiver comprises circuitry for filtering signals responsive to the transmissions by the first and second antennas.

22. The network of claim 21 wherein the wireless receiver further comprises circuitry for despreading the signals responsive to the transmissions by the first antenna separately from circuitry for despreading the signals responsive to the transmissions by the second antenna.

23. The network of claim 22 wherein the wireless receiver further comprises circuitry for equalizing the signals responsive to the transmissions by the first antenna separately from circuitry for equalizing the signals responsive to the transmissions by the second antenna.

24. The network of claim 23 wherein the circuitry for despreading provides an input to the circuitry for equalizing.

25. The network of claim 23 wherein the circuitry for equalizing provides an input to the circuitry for despreading.

26. The network of claim 21 wherein the wireless receiver further comprises:

circuitry for despreading the signals responsive to the transmissions by the first and second antennas; and

circuitry for equalizing the signals responsive to the transmissions by the first and second antennas.

27. The network of claim 21 wherein the wireless receiver further comprises a plurality of receive antennas.

28. A wireless receiver for receiving transmissions by a transmitter comprising a first antenna and a second antenna, the wireless receiver comprising:

circuitry for filtering signals responsive to the transmissions by the first and second antennas; and

circuitry for equalizing signals responsive to the first antenna separately from circuitry for equalizing signals responsive to the second antenna.

29. The wireless receiver of claim 28 wherein the circuitry for filtering comprises circuitry for despreading the signals responsive to the transmissions by the first and second antennas.

30. The wireless receiver of claim 29 wherein the circuitry for filtering comprises circuitry for STTD decoding and rake processing following the circuitry for despreading.

31. The wireless receiver of claim 29 wherein the circuitry for filtering comprises circuitry for despreading following circuitry for STTD decoding and rake processing.

32. The wireless receiver of claim 28 wherein the wireless receiver further comprises circuitry for despreading the signals responsive to the transmissions by the first antenna separately from circuitry for despreading the signals responsive to the transmissions by the second antenna.

33. The wireless receiver of claim 32 wherein the circuitry for despreading provides an input to the circuitry for equalizing.

34. The wireless receiver of claim 32 wherein the circuitry for equalizing provides an input to the circuitry for despreading.

35. The wireless receiver of claim 28 wherein the wireless receiver further comprises a plurality of receive antennas.

36. The wireless receiver of claim 36 wherein the transmitter comprises:

a plurality of antennas comprising the first antenna and the second antenna, wherein each of the plurality of antennas is operable for transmitting signals;

for each of a plurality of different user channels, circuitry for providing a plurality of groups of symbols in a first symbol group sequence;

for each of the plurality of different user channels, circuitry for forming a first modulated symbol group sequence for the user channel by modulating the symbols in the first symbol group sequence for the user channel with a unique code that corresponds to the user channel and distinguishes the user channel from each other of the plurality of different user channels;

circuitry for combining the first modulated symbol group sequence for each of the plurality of different user channels such that a first combined modulated symbol sequence is provided to and transmitted by a first antenna in the plurality of antennas;

for each of the plurality of different user channels, circuitry for forming a second symbol group sequence by re-ordering the groups of symbols in the first symbol group sequence and further by time reversing symbols in at least some of the groups of symbols to form the second symbol group sequence different from the first symbol group sequence;

for each of the plurality of different user channels, circuitry for forming a second modulated symbol group sequence for the user channel by modulating the symbols in the second symbol group sequence for the user channel with a unique code that corresponds to the user and distinguishes the user from each other of the plurality of different user channels; and

circuitry for combining the second modulated symbol group sequence for each of the plurality of different user channels such that a second combined modulated symbol sequence is provided to and transmitted by the second antenna; and

wherein the circuitry for filtering comprises a buffer for storing a number of chips equal to a number of chips in the plurality of groups of symbols.

37. A wireless transmitter, comprising:

a plurality of antennas comprising a first antenna and a second antenna, wherein each of the plurality of antennas is operable for transmitting signals;

for each of a plurality of different user channels, circuitry for providing a first sequence of symbols;

for each of the plurality of different user channels, circuitry for modulating the first sequence of symbols of the user channel with a unique code that corresponds to the user channel and distinguishes the user channel from each other of the plurality of different user channels to produce a first modulated symbol sequence for the user;

circuitry for combining the first modulated symbol sequence for each of the plurality of different user channels such that a first combined modulated symbol sequence is provided to and transmitted by the first antenna;

for each of the plurality of different user channels, circuitry for re-ordering the first sequence of symbols for each user channel into a second sequence of symbols comprising symbols time reversed relative to the first sequence of symbols;

for each of the plurality of different user channels, circuitry for modulating the second sequence of symbols of the user channel with a unique code that corresponds to the user channel and distinguishes the user channel from each other of the plurality of different user channels to produce a second modulated symbol sequence for the user;

circuitry for combining the second modulated symbol sequence for each of the plurality of different user channels such that a second combined modulated symbol sequence is provided to and transmitted by the second antenna.

38. The network of claim 37 wherein the first combined modulated symbol sequence is transmitted by the first antenna at a time different than a time when the second combined modulated symbol sequence is transmitted by the second antenna.

39. The network of claim 37 wherein the unique code used by the circuitry for modulating the second sequence of symbols is the same for a given user channel in the plurality of user channels as the unique code used by the circuitry for modulating the first sequence of symbols for the given user channel.

40. The network of claim 37 wherein the unique code used by the circuitry for modulating the second sequence of symbols is time reversed for a given user channel in the plurality of user channels relative to the unique code used by the circuitry for modulating the first sequence of symbols for the given user channel.

41. The network of claim 37:

wherein the first sequence of symbols comprises a group of symbols in a plurality of groups of symbols;

wherein each group of the plurality of groups of symbols comprises a like number of symbols;

wherein the wireless transmitter further comprises circuitry for buffering a number of the groups of symbols for each of the plurality of user channels; and

wherein the number of buffered groups of symbols equals the number of the plurality of antennas.

42. The network of claim 41:

wherein the number of the plurality of antennas equals two antennas;

wherein the buffered groups of symbols comprise a first symbol group followed by a second symbol group; and

wherein the second symbol group comprises the first sequence of symbols.

43. The network of claim 42 wherein the transmitter further comprises circuitry for determining a negative value of at least selected ones of the symbols in the second sequence prior to being transmitted by the second antenna.

44. The network of claim 43 wherein the transmitter further comprises circuitry for determining a complex conjugate of each of the symbols in the second sequence prior to being transmitted by the second antenna.

45. A method of operating a wireless communication network, comprising:

operating a wireless transmitter, comprising a plurality of antennas, wherein each of the plurality of antennas is operable for transmitting signals, and comprising the steps of:

for each of a plurality of different user channels, providing a plurality of groups of symbols in a first symbol group sequence;

for each of the plurality of different user channels, forming a first modulated symbol group sequence for the user channel by modulating the symbols in the first symbol group sequence for the user channel with a unique code that corresponds to the user channel and distinguishes the user channel from each other of the plurality of different user channels;

combining the first modulated symbol group sequence for each of the plurality of different user channels such that a first combined modulated symbol sequence is provided to and transmitted by a first antenna in the plurality of antennas;

for each of the plurality of different user channels, forming a second symbol group sequence by re-ordering the groups of symbols in the first symbol group sequence and further by time reversing symbols in at least some of the groups of symbols to form the second symbol group sequence different from the first symbol group sequence;

for each of the plurality of different user channels, forming a second modulated symbol group sequence for the user channel by modulating the symbols in the second symbol group sequence for the user channel with a unique code that corresponds to the user and distinguishes the user from each other of the plurality of different user channels; and

combining the second modulated symbol group sequence for each of the plurality of different user channels such that a second combined modulated symbol sequence is provided to and transmitted by the second antenna.

46. The method of claim 45 wherein the unique code used for forming a first modulated symbol group sequence is the same for a given user channel in the plurality of different user channels as the unique code used by for forming a second modulated symbol group sequence.

47. The method of claim 45 wherein the unique code used by the circuitry for forming a first modulated symbol group sequence is time reversed for a given user channel in the plurality of different user channels relative to the unique code used by the circuitry for forming a second modulated symbol group sequence.

48. The method of claim 45 wherein the step of forming a second symbol group sequence forms the second symbol group sequence further by determining a complex conjugate of the symbols in the first symbol group sequence.

49. The method of claim 48 wherein the step of forming a second symbol group sequence forms the second symbol group sequence further by determining a negative of the symbols in selected groups of symbols within the first symbol group sequence.

50. The method of claim 45 and further comprising operating a wireless receiver for receiving transmissions by the first and second antennas.

51. The method of claim 50 wherein the step of operating wireless receiver comprises filtering signals responsive to the transmissions by the first and second antennas.

52. The method of claim 51 wherein the step of filtering comprises despreading the signals responsive to the transmissions by the first and second antennas.

53. The method of claim 52 wherein the step of operating a wireless receiver further equalizing signals responsive to the first antenna separately from equalizing signals responsive to the second antenna.

54. A method of operating a wireless transmitter comprising a plurality of antennas, wherein each of the plurality of antennas is operable for transmitting signals, the method comprising:

for each of a plurality of different user channels, providing a plurality of groups of symbols in a first symbol group sequence;

for each of the plurality of different user channels, forming a first modulated symbol group sequence for the user channel by modulating the symbols in the first symbol group sequence for the user channel with a unique code that corresponds to the user channel and distinguishes the user channel from each other of the plurality of different user channels;

combining the first modulated symbol group sequence for each of the plurality of different user channels such that a first combined modulated symbol sequence is provided to and transmitted by a first antenna in the plurality of antennas;

for each of the plurality of different user channels, forming a second symbol group sequence by re-ordering the plurality of groups of symbols in the first symbol group sequence and further by time reversing symbols in at least some of the plurality of groups of symbols to form the second symbol group sequence different from the first symbol group sequence;

for each of the plurality of different user channels, forming a second modulated symbol group sequence for the user channel by modulating the symbols in the second symbol group sequence for the user channel with a unique code that corresponds to the user and distinguishes the user from each other of the plurality of different user channels; and

combining the second modulated symbol group sequence for each of the plurality of different user channels such that a second combined modulated symbol sequence is provided to and transmitted by the second antenna.

55. A method of operating a wireless receiver, comprising the steps of:

receiving transmissions by a transmitter comprising a first antenna and a second antenna;

filtering signals responsive to the transmissions by the first and second antennas; and

equalizing signals responsive to the first antenna separately from circuitry for equalizing signals responsive to the second antenna.

56. The method of claim 55 wherein the step of filtering comprises despreading the signals responsive to the transmissions by the first and second antennas.

57. The method of claim 56 wherein the step of filtering comprises STTD decoding and rake processing following the step of despreading.

58. The method of claim 56 wherein the step of filtering comprises despreading following the step of STTD decoding and rake processing.

59. The method of claim 55 wherein the step of filtering comprises despreading the signals responsive to the transmissions by the first antenna separately from despreading the signals responsive to the transmissions by the second antenna.

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